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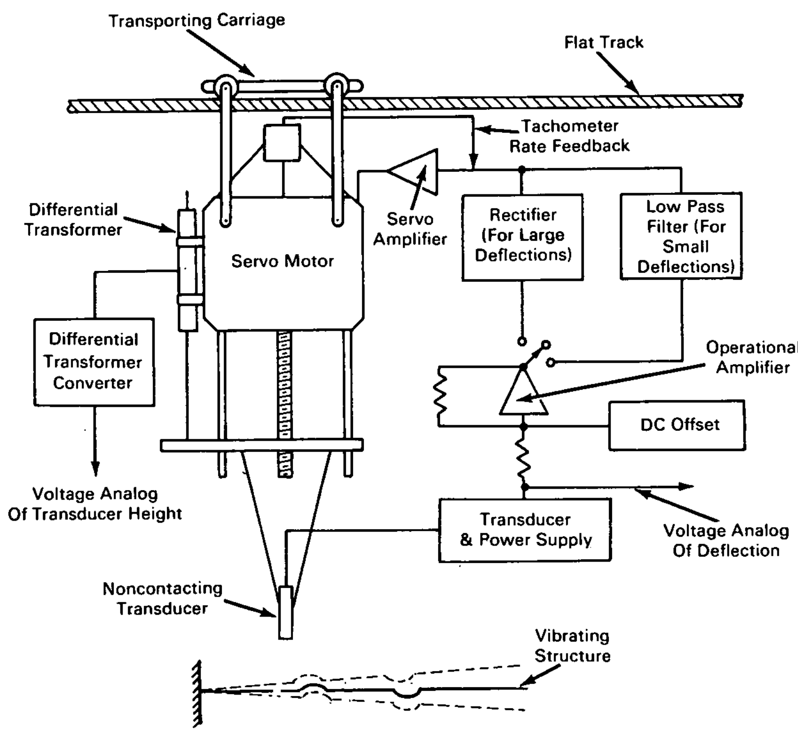
Noncontacting Vibration Transducer Has Constant Sensitivity



The problem: To devise an instrument of constant sensitivity using a noncontacting transducer for automatically measuring the vibration amplitudes (deflections) along the span of a vibrating structure of irregular contour. Previous instruments for measuring vibration amplitudes in this type of structure not only required the use of profile guides and manual adjustments to keep the noncontacting transducer at a fixed average distance from the vibrating surface, but also had a very limited amplitude range. In addition, it was impossible to fabricate profile guides when the structures were subject to nonpredictable deformations.

The solution: A system employing a feedback control (servo loop) to position the noncontacting vibration transducer at a constant height above the test surface. A differential transformer is incorporated to facilitate calibration and extend the amplitude range of the system. Except for the transporting carriage, all components of the system are standard commercially available items.

How it's done: The noncontacting transducer is physically connected to the servo motor, which is moved along the span of the test structure by the trans-

(continued overleaf)

porting carriage. The initial height of the transducer above a fixed point on the static test surface is set by manually adjusting the dc offset to produce a zero voltage at the input to the operational amplifier. Any change in height of the transducer will then result in a dc voltage component from the transducer to the operational amplifier which will cause the servo motor to reposition the transducer to its initial height. The transducer will thus be constrained to follow the contour of the test structure as the transporting carriage moves along the track. The ac voltage output from the transducer, which is an analog of the vibration amplitude of the test structure at the point of measurement, is passed to a convenient readout device.

When vibration amplitudes are less than 0.1 inch, the output from the operational amplifier is connected to the low-pass filter (5-cps cutoff) to block vibration signals from the transducer. Rate feedback generated by the tachometer suppresses oscillations in the feedback control system.

Large vibration amplitudes, up to one inch, are measured by making the noncontacting transducer follow the envelope of the vibration signal. In order to accomplish this, the low-pass filter is replaced by the rectifier, and the voltage output is obtained from the differential transformer converter. Vibration amplitudes of this magnitude require two consecutive sweeps and plots of the test surface, one sweep and plot for the static condition and one for the vibrating condition. The point-by-point differences between the two plots are proportional to the vibration amplitudes.

Notes:

1. The transporting carriage was designed to move the noncontacting transducer automatically in equal adjustable steps over a 20-inch span of a vibrating test panel.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Langley Station
   Hampton, Virginia, 23365
   Reference: B65-10392

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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